

## Tennessee Department of Transportation Division of Materials and Tests

### Submittal and Approval of Concrete Mixture Designs (SOP 4-4)

**Purpose:** The purpose of this document is to establish a submittal and approval process for all concrete mixtures including ready-mixed, prestressed, precast and volumetric mixed concrete.

**Discussion:** Concrete designs submitted to TDOT for approval must exhibit certain physical performance properties indicated in TDOT Standard Specifications including but not limited to slump/slump flow, air content, temperature, unit weight, and yield; the hardened concrete must meet compressive strength.

**Procedure:** A concrete mix design shall be subject to the following procedures prior to being approved for use in TDOT work:

A Concrete Mix Design Technician (Level 3) or a registered Professional Engineer licensed by the State of Tennessee shall use volumetric mix design procedures. The proportions of all materials shall be in accordance with the appropriate TDOT Standard Specifications 501.03(A), 604.03(A), 615.09, and [SOP 5-3](#) (Manufacture and Acceptance of Precast Drainage Structures, Noise Wall Panels, and Earth Retaining Wall Products) Section 5.0.

A trial batch shall be mixed according to those proportions, including appropriate admixtures. The tests for the freshly-mixed concrete shall be conducted to determine:

- |                     |                                     |
|---------------------|-------------------------------------|
| • Slump             | ASTM C 143/AASHTO T 119             |
| • Slump Flow        | ASTM C1611                          |
| • Temperature       | ASTM C 1064                         |
| • Air Content       | ASTM C 231/C 173/AASHTO T 152/T 196 |
| • Unit Weight/Yield | ASTM C 138/AASHTO T 121             |

Gradations and specific gravities for coarse and fine aggregates used in the trial batch shall reflect the characteristics of the stockpiles to be used in the mix. The hardened specimens, after proper curing, shall then be tested for compressive strength. Any trial batch mixed for Class SCC, P-SCC, and SH-SCC shall be verified in the presence of Regional Materials and Tests per TDOT Standard Specifications 604.03(A) and 615.09.

1. If all test results meet the required mix design criteria and field performance tolerances, the producer shall submit a concrete mix design to Headquarters Materials & Test (HQMT) no less than fourteen (14) working days prior to mix production. Ready mixed submittals must be listed on the current

version of the [Concrete Mix Design Template](#). Precast or prestressed submittals must be listed on the [Precast/Prestressed Mix Design Template](#). Ready mixed or prestressed designs shall be emailed to [TDOT.Concrete.Email@tn.gov](mailto:TDOT.Concrete.Email@tn.gov). Precast designs shall be emailed to [TDOT.PrecastMTR@tn.gov](mailto:TDOT.PrecastMTR@tn.gov). Once approved by HQMT, the new designs can be associated to another contract via the [Concrete Design Contract Association Request Form](#).

2. **Approved concrete mix designs will expire at the end of each calendar year (i.e. December 31<sup>st</sup>).**
3. Mix designs will be subject to expiration upon review if design strength or field requirements are not met.
4. Design association requests shall not be allowed for Class X, SCC, P-SCC, and SH-SCC designs. Any Class X mix design shall be accompanied with a plans sheet detailing the item used and the mix design criteria.
5. Email subject lines must state whether the design is a new or existing design along with the contract number. Any submitted mix designs intended to be used for riding surfaces requiring the use of surface aggregate materials, e.g., Class CP, Class DS, and Class A Paving, should include “Surface Aggregates Required” in the body of the email.
6. Class X mix designs for local programs projects shall be approved by the Local Government administering the project.

**Materials:**

**Cement:** The source and location must be listed on the [Qualified Products List \(QPL 15\)](#) and meet the requirements outlined in Section 901.01 of the TDOT Standard Specifications. Any change of cement shall require a new submittal, including a new trial batch complete with test results **unless otherwise directed by HQMT**.

**Fly Ash:** The source and location must be listed on the [QPL 16](#) and meet the requirements outlined in Section 921.15 of the TDOT Standard Specifications. Any change of fly ash shall require a new submittal, including a new trial batch complete with test results, with the exception of an emergency fly ash outage as specified below. Fly ash replacement shall be in accordance with TDOT Standard Specifications 501.03(A) or 604.03(A).

In the event that a project may be delayed due to a fly ash outage, the source of fly ash may be changed to another approved fly ash source listed on [QPL 16](#). A new mix design template worksheet shall be submitted to Headquarters Materials and Tests for review, but a new trial batch will not be required. In the body of the mix design submittal email, a detailed message of the substitution shall be provided. Upon review and approval, a new mix design number will be assigned to the new design with the substituted fly ash.

**Ground Granulated Blast Furnace Slag (GGBFS):** The source and location must be listed on the [QPL 16](#) and meet the requirements outlined in Section 921.16 of the TDOT Standard Specifications. Any change of GGBFS shall require a new submittal, including a new trial batch complete with test results. GGBFS

replacement shall be in accordance with TDOT Standard Specifications 501.03(A) or 604.03(A).

Silica Fume: The source and location must be listed on the [QPL 16](#). Any change of silica fume shall require a new submittal, including a new trial batch complete with test results.

Water: Refer to TDOT Standard Specification 921.01. Non-municipal water sources shall provide their most recent water results per Table 921.01-1 and 921.01-2 of the TDOT Standard Specification along with the mix design submittal package.

Coarse Aggregate: The source and location must be from an approved source meeting quality test requirements outlined in Section 903.03 of the TDOT Standard Specifications.

Where approved surface aggregates are required as per TDOT Standard Specifications 903.03, coarse aggregates must meet the specifications stated in 903.24. The [TDOT Approved Surface Aggregates](#) list outlines all of the approved sources.

In the event that a project may be delayed due to an insufficient supply of coarse aggregate, the source of aggregate may be changed to another approved source of like material (e.g. limestone for limestone, or granite for granite) provided the specific gravity of the new material is within 0.15 of the original material.

Fine Aggregate: The source and location must be from an approved source meeting quality test requirements outlined in Section 903.01 of the TDOT Standard Specifications.

Any change of fine aggregate shall require a new submittal, including a new trial batch complete with test results. Manufactured sand shall not be used in mixes designed as surface courses.

Chemical Admixtures: All admixtures must be listed on the [QPL 4](#) and, in a given mix, must all be supplied by the same manufacturer. Admixture dosage rates (oz/cwt) used in the trial batch shall be submitted on the Concrete Mix Design Template.

### **Distribution:**

Once the design submittal is approved, the design will be distributed as follows:

- A copy is kept on file at HQMT
- Regional Materials and Tests and the producer will receive an electronic copy.
  - Regional Materials and Tests will forward copies to the Project Supervisor; the Project Supervisor will ensure that the Project Inspector receives a copy

The [Concrete Mix Design Submittal and Approval Process Flowchart](#) illustrates the distribution of an approved concrete mix design.